GROUNDWATER INFORMATION SHEET

Boron (B)

The purpose of this groundwater information sheet is to provide general information regarding a specific constituent of concern (COC). The following information is pulled from a variety of data sources and mainly relates to drinking water. For additional information, the reader is encouraged to consult the references cited at the end of the information sheet.

GENERAL INFORMATION	
Constituent of Concern	Boron (B)
Aliases	None
Chemical Formula	B
CAS No.	7440-42-8
Storet No.	01020 (dissolved); 01022 (total)
Summary	The California Department of Public Health (CDPH) regulates boron as a drinking water contaminant. The current State Notification Level (NL) for boron, set by CDPH, is 1,000 µg/L (1 mg/L). The most prevalent sources of boron in drinking water are natural sources, contamination from wastewater, and contamination from fertilizers/pesticides that contain boron. Based on CDPH data through 2010, 286 of approximately 13,000 public drinking water sources have had concentrations of boron greater than 1 mg/L. Most boron detections have occurred in Yolo, San Joaquin, and Kern counties.

REGULATORY AND WATER QUALITY LEVELS[1]		
Type	**Agency**	**Concentration**
Federal	US EPA	NA[2]
State Notification Level (NL)[3]	CDPH	1,000 µg/L
Detection Limit for Purposes of Reporting (DLR)	CDPH	100 µg/L

[1]These levels generally relate to drinking water, other water quality levels may exist. For further information, see *A Compilation of Water Quality Goals* (Marshack, 2008).

[2]There is no Federal regulatory standard for boron in drinking water.

[3] Notification levels are non-regulatory health-based advisory levels established by CDPH for chemicals for which maximum contaminant levels have not been established.

SUMMARY OF DETECTIONS IN PUBLIC DRINKING WATER WELLS[4,5]	
Detection Type	**Number of Groundwater Sources**
Number of active and standby public groundwater sources with a boron concentration > 1,000 µg/L.	286 of approximately 13,000 total sources (total sources includes ADI[6] wells)
Top 3 counties with active and standby public groundwater sources with a boron concentration >1,000 µg/L.	Yolo (33), San Joaquin (30), and Kern (24)

[4]Based on CDPH data collected from 1980-2010 (GeoTracker GAMA)

[5]In general, drinking water from active and standby wells is treated or blended so consumers are not exposed to water exceeding MCLs. Private domestic wells and wells used by small water systems not regulated by CDPH are not included in these figures.

[6]ADI = Abandoned, Destroyed, and Inactive Wells

ANALYTICAL INFORMATION		
Method	**Detection Limit (Quantitation Limit)**	**Note**
EPA 200.7	3 µg/L	CDPH approved for public drinking water systems
Analytical Notes	Boron samples can be contaminated by borosilicate (pyrex) glass. Only plastic or polytetrafluoroethylene (PTFE) materials should be used when collecting, storing, or handling water samples for boron analysis.	
Public Drinking Water Testing Requirements	Public water systems are required to test for boron on a schedule established by CDPH. When boron is detected at levels greater than the NL, the utility or responsible agency must report that detection to relevant public agencies. Based on available scientific information, chemicals with notifications do not pose a significant health risk, but warrant additional public notification as to the presence of that chemical in the water supply. State law requires timely notification of local governing bodies by a drinking water system whenever a notification level is exceeded in a drinking water source. CDPH recommends that the water utility inform consumers about the presence of the chemicals and the health risks associated with exposure to it. If the chemical is present at concentrations above a 'response level' CDPH recommends source removal. The response level for boron is ten times the NL, or 10,000 µg/L (10 mg/L). However, in California utilities are not required to serve water with boron concentrations below the NL.	

BORON OCCURRENCE	
Anthropogenic Sources	Glass production accounts for most boron use. In 2003, 78% of all boron compounds used in the United States were consumed in manufacturing glass. Soaps and detergents (4% of all boron used in the United States), fire retardants (4%), and fertilizers/pesticides (3%) are also major sources of boron. Major anthropogenic sources to water include industrial wastewater discharges, municipal wastewater discharges (including discharges from onsite septic treatment systems), and agricultural uses. Power plants and other manufacturing activities can also release boron to the atmosphere.
Natural Sources	Boron does not occur in elemental form in nature. Boron has a high affinity for forming very stable bonds with electronegative atoms (atoms that donate electrons), and as a result often exists in compounds bound to oxygen atoms. In most cases, the term “boron” is a generic term used to refer to the concentration of boron-containing compounds in water. Boron-containing minerals are common in nature as Na and Ca-borates, borosilicate minerals, and boric acid. Examples of natural borate minerals include borax, borax pentahydrate, ulexite, and inyoite. Boron concentrations in groundwater are derived from leaching of rocks and soils that contain borate and borosilicate minerals. Boron is a major constituent of seawater, and is found in evaporite deposits and other types of sedimentary rocks. Boron is a significant component of playa lake deposits, and major boron deposits are found in the desert southeast of California. The world’s largest boron mine, and California’s largest open-pit mine, is located near the town of Boron, California.
History of Occurrence	According to the United States Geological Survey, the US was the world’s leading producer of refined boron compounds in 2004 and 2005, producing over 1,210,000 metric tons. The use of boron in some cleaning agents is beginning to decrease due to environmental concerns. However, boron compounds are among the most widely used whitening agents used today.
Contaminant Transport Characteristics	Elemental boron is insoluble in water; however, borate minerals including borax, borax pentahydrate, and anhydrous borax are extremely soluble in water. Once boron compounds dissolve, they generally act as a salt (dissolved ion) and are difficult to remove.

REMEDIATION & TREATMENT TECHNOLOGIES
Reverse osmosis or distillation units are effective boron treatment methods. Distillation involves producing, collecting, and condensing steam; boron and other impurities do not travel with the steam and are left out of the condensate. Reverse osmosis places water under pressure and forces the water through a fine membrane that keeps boron and other minerals out. Both distillation and reverse osmosis are costly, require significant time and energy to operate efficiently, and require approximately three times the amount of water. Both methods are low-yield systems, and storage space is needed for the treated water. Blow-down or reject water must be safely disposed of, as well. Ion exchange with a boron-specific exchange resin has also proved effective. Boiling, over-the-counter water filters (pitcher filters or faucet-attachment filters), and water softeners generally do not remove boron from drinking water. Do not boil water to reduce boron concentrations; boiling water will actually increase the overall boron concentration in the water.

HEALTH EFFECT INFORMATION
Most human exposure to boron comes either in the form of boric acid or as borax. Boric acid is the form of boron most likely to be encountered in drinking water, and can be lethal at very high concentrations. Other symptoms of boric acid ingestion include gastrointestinal tract distress, vomiting, abdominal pain, diarrhea, and nausea. In general, these symptoms occur at exposures far greater than those that generally result from ingestion of drinking water. Animal studies have observed reproductive and developmental effects when boron was ingested at high levels. Boron may also be a trace micronutrient that appears to affect utilization and metabolism of other important substances including calcium, copper, magnesium, nitrogen, glucose, trigliceryides, reactive oxygen, and estrogen.

ADDITIONAL RESOURCES
BORON IN DRINKING WATER

1. United States Environmental Protection Agency. 2008. Drinking Water Health Advisory for Boron

2. World Health Organization. 1998. Guidelines for drinking-water quality: Boron in Drinking-water. Addendum to Vol. 2 *Health criteria and other supporting information.*

3. Minnesota Pollution Control Agency. 1998. Boron in Minnesota's Ground Water.

4. Minnesota Department of Health. Drinking Water Protection Section. Boron in Drinking Water; Information for Users of Pathfinder Village Public Water Supply.

5. United States Environmental Protection Agency. 2008. Summary Document from the Health Advisory for Boron and Compounds.

6. State Water Resources Control Board. 2010. GeoTracker GAMA Groundwater Quality Database. http://www.waterboards.ca.gov/gama/

7. Central Valley Regional Water Quality Control Board. 2008. A compilation of Water Quality Goals. By J.B. Marshack. http://www.waterboards.ca.gov/centralvalley/water_issues/water_quality_standards_limits/water_quality_goals/index.shtml

FOR MORE INFORMATION, CONTACT:
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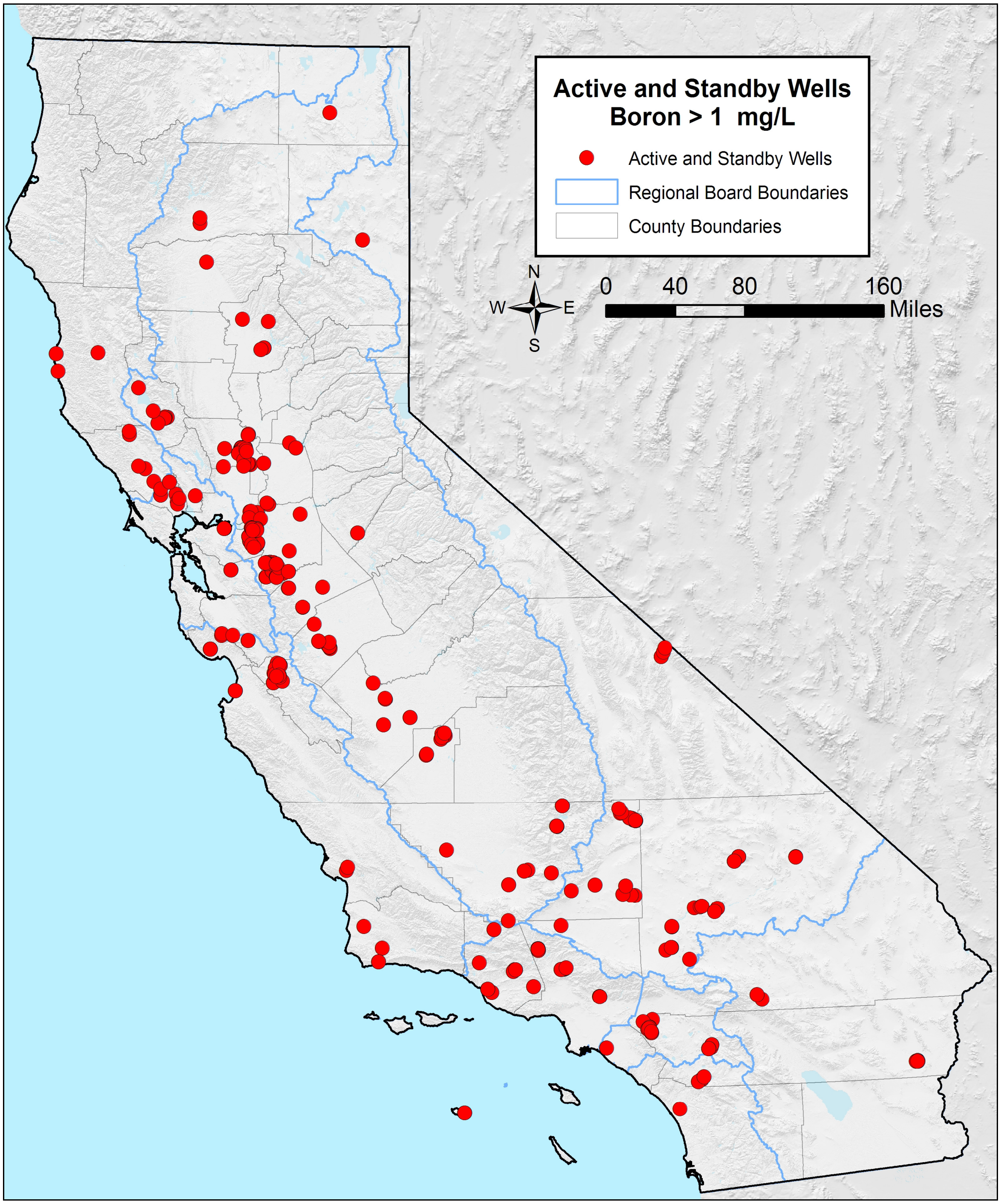
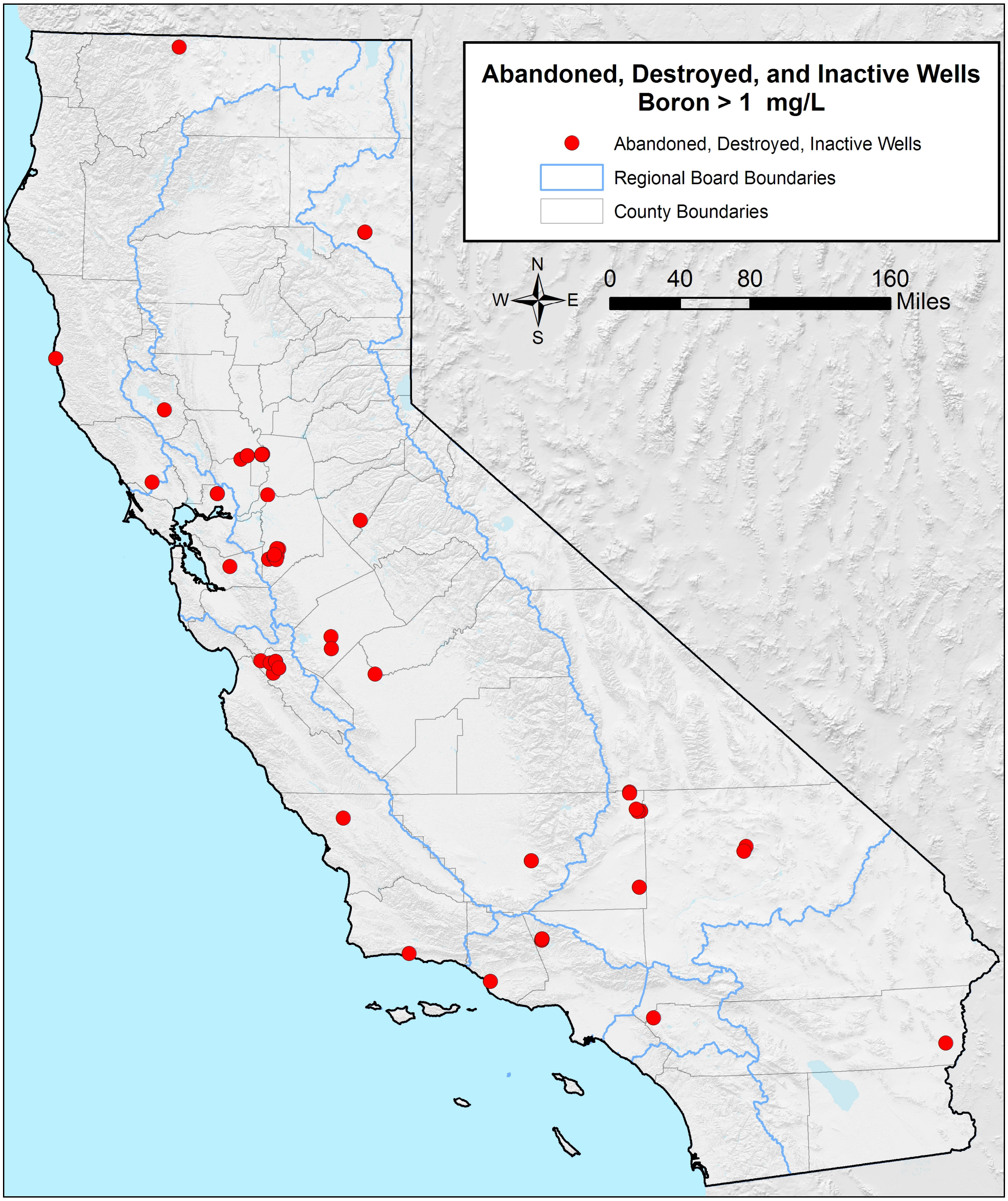


Active and Standby CDPH Wells with at least one detection of boron > 1,000 µg/L Notification Level (286 Wells).

Source: 1980-2010 CDPH Data from GeoTracker GAMA. (*Revised 4-21-10 by E. Ekdahl*)



Abandoned, Destroyed, and Inactive (ADI) Wells with at least one detection of boron > 1,000 µg/L Notification Level (44 Wells).

Source: 1980-2010 CDPH Data from GeoTracker GAMA. (*Revised 4-21-10 by E. Ekdahl*)